Scattering Solar Thermal Concentrators

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DE-EE0005798 | May 15, 2013 | Giebink

PROJECT OBJECTIVES

Goal:

- Concentrate sunlight without mirror movement
  - eliminate tracking error due to wind-loading
  - improved reliability due to fewer moving parts
  - fixed heat transfer elements → simplify design and increase reliability.

Innovation:

- Novel approach to concentrate sunlight
- Potentially compatible with self-adaptive material responses to eliminate need for mechanical tracking entirely

Milestones:

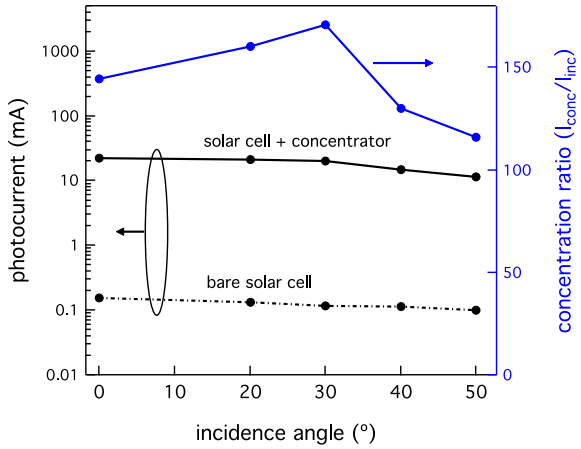
- Achieved second milestone simulated scattering element performance, exceeding 70% coupling efficiency into the guide sheet

APPROACH

- Rigorous ray tracing simulation in Zemax for full system optical design
- Optimized nonimaging element for waveguide coupling
- Fabricated and tested collection optic performance
- Collaborating with LUXeXcel to fabricate custom optical arrays

KEY RESULTS AND OUTCOMES

- Complete concentrator system modeling: optical efficiency >60% at G=112x for incidence angles ranging 0-60°.
- Tested first collection optic → promising
- Manuscript published in Advanced Energy Materials
- Submitted invention disclosure on microtracking microcell CPV



NEXT MILESTONES

- Test scattering element efficiencies in the lab
- Construct optimized lenslet arrays in collaboration with LUXeXcel
- Test complete lenslet array collection optic performance with photovoltaic microcells made in collaboration with University of Illinois.

➢ On track to achieve upcoming milestone M1.3 for demonstrated collection optic coupling efficiency.

➢ Parallel development of microtracking microcell concentration → exciting development for CPV as well as CSP

➢ Self-adaptive strategies continue to be pursued. They are riskiest aspect of our effort at this stage, but carry high reward if successful